Timetable of Mk 31/37 Events

Mid-1953 Development of gas boosting offers possibility of small-diameter atomic devices.

(b)(1), (b)(3)

4/14/54 Military characteristics for boosted air-defense warheads with diameters of 22 and 30 inches issued.

12/13/54 Army requests that AEC develop Mk 7 and 30-inch-diameter warheads for application to NIKE missile.

1/12/55 Division of Military Application authorizes development of 30-inch-diameter warhead.

3/11/55 Santa Fe Operations Office issues scope of work covering design of adaption kits for XW-7 and 30-inch-diameter warheads for NIKE-B application.

(b)(1), (b)(3)

6/24/55 Assistant Secretary of Defense requests feasibility study of high-yield warhead for NIKE-B.

8/31/55 Division of Military Application requests development of high-yield warhead for NIKE-B.

(b)(1), (b)(3)

1/27/56 High-yield XW-37/NIKE-B program approved for development by the Assistant Secretary of Defense.

(b)(1), (b)(3)

6/27/56 Sandia presents proposed ordnance characteristics of XW-31/37 to Special Weapons Development Board.

9/17/56 XW-31 becomes the XW-31-Y1 and XW-37 becomes the XW-31-Y2. Decision made to use uranium-235 in nuclear assembly of XW-31 rather than composite assembly of uranium-235 and plutonium.

10/18/56	Proposed ordnance characteristics of the XW-31/37 NIKE-B application forwarded to Division of Military Application.
10/25/56	Recommendation made that XW-31-Y2 be authorized for marriage with the HONEST JOHN missile.
11/15/56	NIKE-B nomenclature changed to NIKE HERCULES.

(b)(1), (b)(3)

9/18/57	Design-release report of XW-31 presented to Special Weapons Development Board.

(b)(1), (b)(3)

6/58	Design-release report of NIKE HERCULES adaption kit published.
10/58	Mk 31 Mod 0 NIKE HERCULES becomes operationally available.
10/59	Mk 31 Mod 0/HONEST JOHN becomes operationally available.
6/60	Final evaluation of Mk 31 Mod 0 Warhead published.
6/60	Final evaluation of Mk 31/NIKE HERCULES application published.

<u>Mk 31 Mod 1 (Atomic Demolition Munition)</u>

10/21/58	Military characteristics for the Mk 31 Atomic Demolition Munition issued.
4/15/59	Albuquerque Operations Office issues authorization to proceed with Mk 31 Mod 1 development.
6/60	Design release accomplished.

9/60	Early production started.
12/7/61	Final evaluation report of Mk 31 Mod 1 Munition accepted by Field Command.

Mk 31 Mod 2 Warhead

3/59	Sandia proposes incorporation of handling safety devices in Mk 31 Warheads.
9/59	Military Liaison Committee accepts proposal.
6/62	Mk 31 Mod 2 Warhead design released.
3/63	Early production of Mk 31 Mod 2 Warhead.
9/13/63	Final development report accepted by Field Command.

CROSSBOW Application

9/53	Study of applicable warheads for CROSSBOW missile started.
9/23/54	Marriage program for XW-7/CROSSBOW approved.
11/55	Study report recommends that the XW-31 Warhead replace the XW-7 for the CROSSBOW application.
1/3/56	Assistant Secretary of Defense authorizes development of XW-31 Warhead for use with CROSSBOW.
1/24/57	CROSSBOW application canceled due to missile problems.

History of the Mk 31/37 Warhead

This program began in mid-1953, when development of gas boosting offered promise that efficient small-diameter atomic devices might be created. (b)(1), (b)(3)

This design would have to meet requirements of immedate readiness, high-g loading, high-altitude functioning, and maximum economy of fissionable material. (b)(1), (b)(3)

Tentative military characteristics had been proposed by the Military Liaison Committee for boosted air-defense warheads with diameters of 22 and 30 inches, and these characteristics were refined and formally released April 14, 1954.[3] The 22-inch-diameter device became the Mk 30, and the 30-inch-diameter design, which will be discussed in this history, became the Mk 31/37.
(b)(1), (b)(3)

The weapon would be able to withstand single-mission flights of 2 hours and a total flight time of 50 hours, and temperatures from -55°F to +165°F. The firing system would be capable of operation at all altitudes from sea level to 100,000 feet. The nuclear insertion system would provide arming within a period of 6 seconds, and safing within 3 seconds. The weapon would be able to remain in a state of functional readiness for a period of at least 30 days.[4]

This 30-inch-diameter warhead was discussed in a meeting of the Joint Committee on NIKE-B Warhead Installations May 12, 1954. It was felt that the XW-7 high-explosive system could be used, and that no safing problems existed. It was noted that this design would result in fewer restrictions on the missile stockpile-to-target sequence than the XW-7 Warhead.[5]

Subsequently, December 13, 1954, the Army requested that both Mk 7 and 30-inch warheads be developed for NIKE application. This request was forwarded to Sandia by Santa Fe Operations Office as interim guidance, although it was noted that formal Military Liaison Committee approval of the 30-inch warhead marriage program had not as yet been received. However, there was a need for this warhead, even though yield, dimensional characteristics, and identification of carriers were not definite, and the program was placed in full development. It was felt that the Military would eventually replace the XW-7 with the 30-inch design. Thus major effort would be placed on the latter, making certain, however, that a suitable warhead would be ready in time to meet the missile availability date.[6]

The Division of Military Application notified Santa Fe Operations Office January 12, 1955, that the Military Liaison Committee directive of April 14, 1954, had only suggested that the 30-inch warhead might be adaptable to the NIKE-B. This was not considered to represent a firm requirement for the missile-warhead combination, but development of the warhead itself was obviously required.[3]

The warhead was discussed in a Special Weapons Development Board meeting January 12, 1955. The principal purpose of the NIKE-B was surface-to-air attack of enemy aircraft, but it was felt that a secondary surface-to-surface mission would be desirable, having either air or contact burst.

It was noted that high accelerations during nuclear insertion and the requirement for an extremely rapid retraction of the capsule on the downward leg of the flight of a malfunctioning missile would tax the capabilities of existing inflight insertion mechanisms. Air motors, powered by bottles of compressed air, were being studied, as well as a barrel-cam mechanism whose operation was similar to that of a lipstick container.

Since the missile might be required to make rather rapid changes in direction, some of which might increase the angle of attack of the missile to as much as 30 degrees, a zero angle of attack or swivel probe was required to provide an accurate pressure-sensing system. Barometric accuracy was important, both to initiate nuclear retraction as close to the ground as possible in the event of malfunction in the surface-to-air mission, and to provide a fuze for the possible secondary surface-to-surface mission.[7]

A scope of work covering design of adaption kits for both XW-7 and 30-inch warheads was approved by Santa Fe Operations Office March 11, 1955, and the Assistant Secretary of Defense authorized development of a 30-inch-diameter or XW-31/NIKE-B missile-warhead March 12, 1955.[8,9]

(b)(1), (b)(3)

(b)(1), (b)(3)

The basic design of the XW-31 Warhead was now firmed up.

A boosted, sealed-pit system would eliminate any need for capsule retraction. First production was predicted for early 1958.

Accurate pressure sensing was a major requirement, to allow the warhead to be armed at the proper point in the trajectory and detonated at a specific altitude. Testing of supersonic missiles had revealed several major sources of error in existing pressure-sensing systems. Any abrupt changes in the direction of missile travel, and these were inherent in NIKE operation, caused errors, since the axis of the probe which formed the inlet to the barometric system would deviate from the direction of air flow, and thus produce unequal pressures under different angular positions.[7] A self-aligning static tube, with the probe mounted on a universal joint, allowing alignment with the airstream, solved this difficulty.

Plumbing-system pressure lags created time-delay errors, and these time lags were aggravated by the total amount of air contained in the system. This was reduced to a minimum by development of baroswitches with an internal volume of 2.7 cubic inches, as compared to 25 cubic inches in similar devices. At the same time, the diameter of the piping was increased, to reduce the effect of skin friction, which delayed system response.

It was found that cylindrical probes were accurate at speeds up to Mach 1.8, but that errors were introduced above this speed. Tapering of the end of the probe to a 1-degree half-angle solved this difficulty and allowed the probe to be calibrated at all airspeeds up to Mach 5.

By June 15, 1955, preliminary layout of the adaption kit for the warhead installation was completed. This included arm/safe switches and low-volume barometric switches for arming and fuzing. These components, with the necessary relays, connectors and wiring would be installed in a sealed container that could be handled as a unit.[12]

nuclear design would be a hollow, gas-boosted system with external initiation.
(b)(3)

This latter would conserve plutonium, then in short supply, and avoid the problems of fabricating thin plutonium shells. Flight tests would start in May 1956, design-release date would be March 1957, and operational availability was scheduled for October 1958.[19]

The Division of Military Application notified Santa Fe Operations Office December 19, 1955, that the Army was considering acceleration of the NIKE-B program. The Military Liaison Committee had requested that Mk 7 development be similarly expedited, to assure warhead availability. (b)(1), (b)(3)

It was felt that this latter device would meet a Joint Chiefs of Staff request for a high-yield air-defense warhead.[20]

On January 27, 1956, development of the XW-37/NIKE-B Warhead was authorized by the Assistant Secretary of Defense. Picatinny Arsenal would represent the Army, and applications to the CORPORAL, HONEST JOHN, SERGEANT and atomic demolition munition would be considered at a later date. Coordination of the project was placed in the hands of the NIKE-B Committee.[21]
(b)(3)

The XW-31/37 would be used primarily for perimeter defense of major population areas and, although the missile batteries would be located some distance away, the warheads could be detonated directly over metropolitan centers.[22] (b)(3)

(b)(1), (b)(3)

(b)(3)

(b)(3)

Meanwhile, sled tests of impact devices had indicated that the best design for fast action and positive indication was a double-shell crush switch located in the nose of the weapon, with piezoelectric crystals pulsing a thyratron trigger circuit. This design had been selected for production, and the missile contractor (Douglas Aircraft Company) was developing a suitable nose compartment. Testing of self-aligning probes were in process, but had encountered instrumentation difficulty which was caused by sensitivity of the vibration pressure pickup to mounting orientation.[25]

A formal feasibility report covering the design of an economical, medium-yield warhead was issued June 1, 1956. (b)(1), (b)(3)

(b)(3)

The gas-boosting system would contain a reservoir containing high-pressure gas, squib-operated valve, and associated tubing. A pit vacuum monitoring system would check for existence of leaks which would degrade the yield through atmospheric corrosion of the nuclear material. Provision would be made to detect tritium leakage during storage or handling, since this gas was a health hazard. (b)(1), (b)(3)

Sandia presented Report SC3752(TR), Proposed Ordnance Characteristics of the XW-31/37 (NIKE-B Application) Atomic Warhead Installation, to the June 27, 1956 meeting of the Special Weapons Development Board.[1] (b)(1), (b)(3)

Both warhead and adaption kit were sealed with the cartridge assembly containing most of the adaption-kit components being attached to the warhead.

(b)(1), (b)(3)

An impact switch held two metal rings mounted inside the weapon nose and insulated at points of contact with the skin. When the skin was crushed against the ring at weapon impact, a firing circuit was completed and the warhead detonated. (b)(3)

The Board accepted the report, subject to inclusion of a warhead reliability study. This information was provided and forwarded to the Division of Military Application October 18, 1956.[27]

By July 1956, systems design of the XW-31/37 Warheads had been completed. Four more sled tests had been performed, and the deformation switch was deemed to be completely satisfactory for NIKE-B impact fuzing applications. Sandia meanwhile had recommended that weapons with multiple yields be assigned a single Mark designation, and that a suffix be used to indicate the yield. This proposal was accepted by Field Command September 17, 1956; the XW-31 thus becoming the XW-31-Y1 and the XW-37 becoming the XW-31-Y2.[28] At this time it was definitely decided to use uranium-235, rather than a composite nuclear system, to conserve plutonium.

Meanwhile, some thought had been given to compatibility of the warhead with the HONEST JOHN missile. The Joint Committee on HONEST JOHN Warhead Installations met October 25, 1956. A longer range version of this missile had been proposed, and a recommendation made that the higher yield XW-31 Warhead be mated to this missile rather than the Mk 7. The longer range HONEST JOHN would have a higher acceleration, and it was felt that the XW-31 would be better able to resist this acceleration.[29] The recommendation was accepted and forwarded to Washington.

NIKE-B missile nomenclature was changed to NIKE HERCULES November 15, 1956, and the intercept capability of the NIKE system was increased from 25 to 50 miles. The Mk 7 flight-test program had meanwhile been delayed due to missile problems, and flight tests with the XW-31-Y2 Warhead were rescheduled to January 1957. It was hoped that the eight flights required for warhead certification could be completed before the scheduled design-release date of June 1957.[30]

(b)(1), (b)(3)

Development was requested of all three warhead combinations, and the Department of the Army was designated cognizant agency for the Department of Defense.[31] An operational availability date of July 1959 was desired, but would depend on the availability of nuclear material.[32]

The Joint Committee on HONEST JOHN Warhead Installations met February 7, 1957. The longer-range rocket promised improvements in deflection, altitude and range accuracy. The rocket weight would be reduced by 1000 pounds and the length by 3 feet through use of a new propulsion unit being developed by Redstone Arsenal, and this would increase the rocket range by 15 percent. Picatinny Arsenal was developing an adaption kit, and it appeared that the XW-31 Warhead could be used with either the old or the improved HONEST JOHN.

(b)(1), (b)(3)

The weight would be identical in all yields, as the lighter versions would be ballasted to that of the heaviest. It was felt that the transistorized power supply of the external initiators might cause trouble, due to sensitivity of these transistors to neutron radiation, and Los Alamos agreed to consider use of internal initiation for some of the XW-31 yields. This would simplify development effort, provide operational simplicity, and allow more positive control of time scales.[33]

(b)(1), (b)(3)

(b)(1), (b)(3)

Report SC4099(TR), Description and Status at Complete Design Release of the XW-31 Warhead, was presented to the September 18, 1957 meeting of the Special Weapons Development Board. The warhead was 29.01 inches in diameter, 39.05 inches long, and weighed 920 pounds. The warhead was compatible with both NIKE HERCULES and HONEST JOHN missiles.[40] (b)(1), (b)(3)

The report was subsequently forwarded to the Division of Military Application February 26, 1958.[42] The Mk 31Y2 Warhead design was released in November 1957, when the external initiator became available.[43] Subsequently, external initiators were deleted from the Y1 and Y3 versions, leaving the Y2 with an external neutron generator.[44]

Meanwhile, the Army Air Defense Board had noted that there was a high probability of receiving a premature command signal from the missile guidance system in the surface-to-surface mode. This was a safety hazard, as it disabled the self-destruct system. If the missile was fired straight up, the warhead would be armed and, when it returned, the warhead would detonate at the fuzing altitude.[45]

This problem was discussed in the November 5, 1957 meeting of the Joint Committee on NIKE HERCULES Warhead Installations, and it was decided that the best solution was to install a timer in parallel with the command signal. Since it was desired that this timer not interfere with the reliability of the primary surface-to-air mission, it should not be incorporated in the guidance-equipment package, and Sandia agreed to place it in the adaption kit. Development of the timer was started immediately, and would be included in the system only when a surface-to-surface plug was installed.[46]

(b)(3)

Meanwhile, difficulties had been encountered on both missile programs. The HONEST JOHN adaption kit slipped 3 months, due to lack of funding.[48] The NIKE HERCULES changed from liquid to solid propellant, and this created difficulties.[49]

(b)(1), (b)(3)

A suitable timer was installed in the warhead, and the guidance computer modified.[50]

Report SC4099(TR), Description and Status at Design Release of the XW-31 Warhead, was released January 1958 by Sandia. This noted that partial design release of the Mk 31 with the Y1, Y2 and Y3 had been accomplished in June 1957, with complete release scheduled for November 1957.[41] (The actual date was March 1958.)

The report noted that the NIKE HERCULES was a two-stage missile, with a solid-propellant booster and sustainer. The sustainer motor ignited when the booster separated (about 35 seconds after launch) and powered the missile for about 32 seconds. After burnout, the missile coasted to the intercept point. Flight duration was between 10 and 200 seconds. The missile was guided throughout its flight after initial boosting.[41]

(b)(1), (b)(3)

(b)(1), (b)(3)

Report SC4243(WD), Final Evaluation Report of the Mk 31 Mod 0 Warhead, was published in June 1960. This noted that the sequence of operation was unchanged from that described in the report at design release.[44] On the same date was published Report SC4242(WD), Final Engineering Evaluation of the M75 Adaption Kit and the Mk 31/NIKE HERCULES Application. This noted that the missile was capable of intercepting aircraft formations at ranges in excess of 50 miles and above 80,000 feet altitude with a circular error of 40 yards at a range of 50 miles. The missile was gound-guided to the target by a computer, which also furnished the burst command. The missile had a single solid-propellant sustainer motor and a solid-propellant booster of four NIKE AJAX Jato's.[50]

The sustainer motor ignited when the booster separated (which was 3 to 4 seconds after launch) and burned for about 30 seconds. After burnout, the missile coasted to intercept. Intercept time varied from 20 to 200 seconds, and the missile was controlled in flight by aerodynamic surfaces on the trailing edges of the four fins which extended along approximately four-fifths of the length of the missile.[50]

Atomic Demolition Munition (Mk 30 Mod 1 Warhead)

The Mk 30 Mod 1 Warhead was designed to fulfill the requirements for the application of the Mk 31 Warhead as an Atomic Demolition Munition. The principal requirements were set forth in the military characteristics dated

October 21, 1958.[60] Authorization to proceed with development was received from Albuquerque Operations Office April 15, 1959.[61]

Some attention had been given to the desirability of incorporating environmental sensing devices in the Mk 31 (see the Mod 2 description) and for a time it was felt that these devices should also be applied to the munition. However, November 12, 1959, the Military Liaison Committee decided that field conversion of Mk 31 Warheads to atomic demolition munition use would not be required. It thus became possible to apply the Mod 2 only to Mk 31 Warheads for missile use. However, a combination lock was required, to provide handling safety for the munition.[62]

Design release of the Mk 31 Mod 1 Atomic Demolition Munition was accomplished in June 1960 and early production in September 1960. In order to meet this date, a lock-secured cover was completely developed in a relatively short time scale. In addition, a thermal plug was incorporated in the boosting-gas-reservoir system which provided added safety in the event that the munition was subjected to a fire environment.[60]

The outside diameter of the Mk 31 Mod 1 was 29.01 inches, length 43.75 inches, and weight 925 pounds. Y1, Y2 and Y3 yields were provided. Report SC4507(WD), Final Evaluation Report of the Mk 31 Mod 1 Warhead,[60] was reviewed in coordination with the interested Services and accepted by Field Command December 7, 1961.[63] It was noted that the design met all requirements of the military characteristics except for a slightly less than desired reliability figure. The report was forwarded to the Division of Military Application February 19, 1962.[64]

31

Mk 30-Mod 2 Warhead

The advent of sealed-pit weapons and the emphasis on immediate operational readiness for air-defense devices had greatly accentuated the need for safety.[65] Protection was required, both against accidents during warhead testing and the deliberate actions of a saboteur or psychotic. Sandia accordingly conducted an investigation and, March 1959, proposed incorporation of a handling safety device in all Mk 31 Warheads.

This device was a velocimeter consisting of a cylinder having a piston with orifices, a pair of normally open operating contacts, and latching and reset features. A breakaway mass was held in place by a restraining spring and a small magnet, and could be separated by applying a force of 2.5 g's. The piston then operated, and the contacts closed and latched.

In April 1959, the Division of Military Application proposed that handling safety devices be added to all Mk 31 Warheads and, September 1959, the Military Liaison Committee requested such incorporation. After design work, Sandia suggested use of an inertial switch, and final approval to proceed with this change was released October 1961. Since production of Mk 31 Mod 0 Warheads was essentially complete at that time, it was decided to retrofit the Y2, Y3 and Y4 warheads in the field at the time their boosting-gas reservoirs were replaced. Y1 warheads would be retrofitted whenever the weapon had to be disassembled for any reason.

Complete engineering release for the Mk 31 Mod 2 Warhead was dated June 1962. Early production of the Y2, Y3 and Y4 inertial switch pack for retrofit was March 1963, and early production of the Y1 switch pack was August 1963. Report SC4782(WD), Final Development Report for the Mk 31 Mod 2 Warhead, was reviewed and approved by Field Command September 13, 1963,[66] and forwarded to the Division of Military Application November 22, 1963.[67]

(b)(1), (b)(3)

Different inertial switch packs, differing only in detail, were used in the two applications. In normal operation, the warhead could not become completely armed until it had experienced a specified flight environment for a certain minimum time.[68]

CROSSBOW Application

Some consideration was given to application of the Mk 31 Warhead to the CROSSBOW, an Air Force air-to-surface missile designed to destroy enemy ground radar installations. The missile, designed and built by the Radioplane Company of Van Nuys, California, would be flown to the launch zone by B-47 or B-52 bomber. The operator in the bomber, after acquiring enemy radar signals, would lock the missile's guidance system on this target. The missile could be released as far as 250 nautical miles from the target and would home on the radar station, detonating on contact.[69]

Study of applicable warheads was started in September 1953 and it was initially decided that either XW-7 or XW-12 use would require relocation of the air induction system and a redesign of the warhead compartment, and that new fuel tanks would have to be provided. Subsequently, however, a more detailed study was conducted and concluded that the XW-7 Warhead could be used. A marriage program for the XW-7/CROSSBOW was approved by the Military September 23, 1954, and Atomic Energy Commission support solicited.

This participation was delayed but, July 11, 1955, the AEC agreed to provide certain fuzing components and consultant services, which were made available by the fall of 1955. Subsequently, use of the XW-31 Warhead was suggested and a feasibility study conducted.[70] The study report was dated November 1955 and recommended that the XW-31 Warhead be used, due to its higher nuclear efficiency and reduced need for support and surveillance, as compared to the XW-7.[71]

(b)(1), (b)(3)

However, difficulties with the missile led to cancella-

made [73]

e o om o $ d 'rf

<u>Deuterium</u> -- The hydrogen isotope of mass number 2.

<u>Division of Military Application</u> -- An AEC office that functions as liaison between the Military and weapons designers and producers.

(b)(1), (b)(3)

<u>Field Command</u> -- The local office of the Armed Forces Special Weapons Project (Defense Atomic Support Agency as it was later called), located on Sandia Base, Albuquerque, New Mexico.

<u>Firing System</u> -- The electrical system of the weapon that produces and applies a high-voltage current to the detonators.

<u>Fuze</u> -- A combination of the arming and firing devices of a weapon.

<u>g</u> -- Force equal to one unit gravity.

<u>Gas Boosting</u> -- The technique of increasing the yield of a nuclear device by introducing deuterium-tritium gas into the implosion process to increase the fission activity.

<u>Guided Missile</u> -- A missile that is directed to its target while in flight or motion, either by a preset self-reacting device within the missile or by radio command outside the missile.

<u>Hardtack</u> -- A nuclear series of 72 tests. Hardtack I was held at the Pacific Proving Grounds from April 28 to August 18, 1958. The decision to declare a moratorium on testing resulted in Hardtack II, held at the Nevada Test Site between September 12 and October 30, 1958.

<u>High-Explosive Sphere</u> -- The ball of high explosive that surrounds the nuclear assembly and is designed to produce the implosion effect when detonated.

(b)(1), (b)(3)

(b)(1), (b)(3)

Jamming -- The practice of defeating radar by providing spurious responses in enemy equipment. Jamming can be passive or active.

Jato -- Named for Jet-Assisted Take-Off. A jet device initially designed to assist heavily loaded aircraft to take off from short runways. Used as a boosting device in missile launching.

Joint Chiefs of Staff -- A group composed of the Chiefs of Staff of the Army, Navy and Air Force, to determine policy and develop joint strategic objectives of the Armed Forces.

Joint Committee on HONEST JOHN Warhead Installations -- A committee, with representatives from nuclear, warhead and missile designer, and the Military, established to guide the activities related to the HONEST JOHN Warhead.

Joint Committee on NIKE-B Warhead Installations -- A committee, with representatives from nuclear, warhead and missile designer, and the Military, established to guide the activities related to the NIKE-B Warhead.

Kiloton -- A means of measuring the yield of an atomic device by comparing its output with the effect of an explosion of TNT. A 1-kiloton yield is equivalent to the detonation effect of 1000 tons of high explosive.

Lenses -- As applied to nuclear weapons, lenses are elements of the high-explosive sphere, which are designed to produce an implosion. The lens charge is composed of high explosives of different burning rates and is so constructed and shaped as to change the explosion initiated by the detonators into an implosive force which converges smoothly on the nuclear materials.

Los Alamos Scientific Laboratory -- A nuclear design organization located at Los Alamos, New Mexico.

Mach -- A measure of speed. Mach 1.0 is the speed of sound, or 738 miles per hour at sea level.

Military Characteristics -- The attributes of a weapon that are desired by the Military.

Military Liaison Committee -- A Department of Defense committee established by the Atomic Energy Act to advise and consult with the AEC on all matters relating to military applications of atomic energy.

Nautical Mile -- A naval measurement of length. One nautical mile is equivalent to 6076.1033 feet, or the length of 1 minute of arc (1/21,600) of a great circle of the earth.

Neutron -- An uncharged particle of slightly greater mass than the proton.

Nuclear Insertion -- Insertion of the nuclear capsule when the weapon is ready to be armed for detonation. An atomic weapon with a retracted capsule is relatively safe, and will only produce a yield equivalent to the amount of high explosive in the weapon if the arming and fuzing sequence was initiated and went to completion.

(b)(3)

(b)(1), (b)(3)

Radar -- Named for Radio Detecting and Ranging. Radars emit a pulse of high-frequency energy and measure the time lapse from that transmission to receipt of a reflected electrical "echo" from an object. This time measurement determines the distance of the object from the transmitting antenna of the radar.

Redstone Arsenal -- An Air Force arsenal, responsible for design of large rockets.

Reservoir -- As used in this history, a container for deuterium-tritium boosting gas.

Retrofit -- To modify a weapon, i.e. "retroactively outfit" it with changed material.

Safing -- Putting a weapon in condition such that it cannot fire.

Senta Fe Operations Office -- The local office of the Atomic Energy Commission (AEC) concerned with the Sandia operations. Renamed Albuquerque Operations Office, April 2, 1956.

Sealed Pit -- A weapon in which all the nuclear components (except the boosting gas, when used) are permanently installed in place. Designed to eliminate the need for inflight nuclear insertion mechanisms.

Special Weapons Development Board -- A joint Sandia-Military board at Sandia Base to provide local guidance on weapons design.

Squib -- A device containing a small powder charge. When detonated, the resulting gas pressure closes a switch or performs a similar action. A light, quick-acting one-shot device.

Supersonic -- Any speed exceeding that of Mach 1.0, which is the speed of sound, or 738 miles per hour at sea level.

Teapot -- A less-than-full scale test series held at the Nevada Test Site. Series of 14 tests, starting February 18 and ending May 15, 1955.

Telemetry -- The transmission of signals from a moving or distant object.

Thermal Battery -- A battery whose electrolyte is in a solid state while inactive. To activate, heat is applied to this electrolyte, melting it and putting the battery into active output condition.

Thyratron -- A grid-controlled electron tube.

Ton (Yield) -- A means of measuring the yield of an atomic device by comparing its output with the effect of an explosion of TNT. A 1-ton yield is equivalent to the detonation effect of 2000 pounds of high explosive.

Transistor -- A nonvacuum electronic device having uses similar to the electron tube, whose control of current is accomplished by the conductive properties of a semiconducter such as germanium.

Tritium -- The hydrogen isotope of mass number 3.

Uranium-235 -- A radioactive element, an isotope of uranium-238.

Uranium-238 -- A radioactive element, atomic number 92. Natural uranium contains about 99.3-percent uranium-238; the rest is uranium-235.

Warhead -- A weapon carried to the target by missile.

X-Unit -- A device used to provide high voltage to the weapon detonators.

Yield -- The measure of the effect of a nuclear detonation compared to the effect of an explosion of TNT.

References

1. (b)(3)

2.

3. SRD Ltr, Division of Military Application to Santa Fe Operations Office, dtd 1/12/55, subject, NIKE-B Warhead Development. AEC Files, MRA-5, NIKE, 7/54.

4. SRD Ltr, Field Command to Distribution, dtd 5/18/54, subject, Transmittal of Military Characteristics. AEC Files, MRA-5, 5/54-6/54.

5. (b)(3)

6. SRD Ltr, Santa Fe Operations Office to Sandia Corporation, dtd 12/23/54, subject, NIKE-B Warhead Development. AEC Files, MRA-5, NIKE, 7/54.

7. SRD Minutes, RS 3466/84055, Special Weapons Development Board to Distribution, dtd 1/12/55, subject, Minutes of 89th Meeting, Part I. SC Archives, Transfer No. 48217.

8. (b)(1), (b)(3)

9. TSRD Report, RS LXI-3132, United States Atomic Energy Commission to Military Liaison Committee, dtd 5/3/55, subject, Weapons Development Status. SC Files.

10. (b)(3)

11.

12. SRD Ltr, Sandia Corporation to Army Ordnance Liaison Officer, dtd 6/15/55, subject, Transmittal of XW-7 and XW-31/NIKE-B Progress Report. AEC Files, MRA-5, NIKE, 7/54.

13. SRD TWX, Division of Military Application to Sandia Corporation, dtd 8/17/55. SC Central Technical Files, XW-7/NIKE-B, 1-, 2-.

41.

(b)(3)

42. CRD Ltr, Sandia Corporation to Division of Military Application, dtd 2/26/58, subject, Forwarding Letter for SC4099(TR). SC Central Technical Files, XW-31, January-June 1958.

43. SRD Ltr, RS 1240/2277, Sandia Corporation to Picatinny Arsenal, dtd 11/20/57, subject, Transmittal of XW-7/XW-31 NIKE HERCULES Progress Report. AEC Files, MRA-5, XW-7, 7/57.

44. SRD Report, RS 3423/88, Sandia Corporation to Distribution, dtd 6/60, subject, Report SC4243(WD), Final Evaluation Report of the Mk 31 Mod 0 Warhead. SC Reports Files.

45. SRD Minutes, Joint Committee on NIKE HERCULES Warhead Installations to Distribution, dtd 11/5/57, subject, Minutes of 14th Meeting. AEC Files, MRA-5.

46. SRD Ltr, RS 3466/81187, Picatinny Arsenal to Sandia Corporation, dtd 11/29/57, subject, Modification of the XM-75 Adaption Kit for the Surface-to-Surface Mission. SC Central Technical Files, XW-31/NIKE HERCULES, 1956-7.

47.

(b)(3)

48. SRD Minutes, Joint Committee on HONEST JOHN Warhead Installations to Distribution, dtd 12/5/57, subject, Minutes of 14th Meeting. AEC Files, MRA-5.

49. SRD Report, RS 1247/112, Division 1247 to Department 1240, Sandia Corporation, dtd 12/9/57, subject, Trip Report, 14th Meeting of the Joint Committee on NIKE HERCULES Warhead Installations. SC Central Technical Files, XW-31/NIKE HERCULES, 1956-7.

50.

(b)(3)

51. SRD Ltr, RS 1000/3237, Sandia Corporation to Albuquerque Operations Office, dtd 3/13/58, subject, XM-50 HONEST JOHN Missile Program. SC Central Technical Files, XW-31/HONEST JOHN.

52. SRD Ltr, Division of Military Application to Albuquerque Operations Office, dtd 3/27/58, subject, XM-50 HONEST JOHN Program. AEC Files, MRA-5, HONEST JOHN, 7/57.

53. SRD Minutes, Joint Committee on NIKE HERCULES Warhead Installations to Distribution, dtd 4/10/58, subject, Minutes of 15th Meeting. AEC Files, MRA-5.

54.

(b)(1), (b)(3)

55. SRD Report, RS 3466/26793, Sandia Corporation to Distribution, dtd 6/58, subject, Report SC4097(TR), Description and Status at Design Release of the M75 Adaption Kit. SC Reports Files.

56.

(b)(3)

57. SRD Minutes, Joint Committee on HONEST JOHN Warhead Installations to Distribution, dtd 5/14/59, subject, Minutes of 17th Meeting. AEC Files, MRA-5.

58.

(b)(3), (b)(1)

59.

60. SRD Report, RS 3423/410, Sandia Corporation to Distribution, dtd 2/62, subject, Report SC4507(WD), Final Evaluation Report of the Mk 31 Mod 1 Warhead. SC Reports Files.

61. SRD Ltr, RS 3466/75562, Albuquerque Operations Office to Distribution, dtd 4/15/59, subject, Phase 3 Authorization for the Application of the Mk 31 and XW-45 Warheads to the Universal Firing Device. SC Central Technical Files, 31 Program, 1-.

62. CRD Ltr, Military Liaison Committee to United States Atomic Energy Commission, dtd 11/12/59. SC Central Technical Files, W31/ADM, 2-18.

63. SRD Ltr, RS 3446/45910, Field Command to Sandia Corporation, dtd 12/7/61, subject, SC4507(WD), Final Development Report of the Mk 31 Mod 1 Warhead. SC Central Technical Files, Mk 31, 1961.

64. Unc Ltr, Sandia Corporation to Division of Military Application, dtd 2/19/62, subject, Forwarding Letter for SC4507(WD). SC Central Technical Files, Mk 31, 1962-4.

65. SRD Minutes, Joint Committee on HONEST JOHN Warhead Installations to Distribution, dtd 11/13/58, subject, Minutes of 16th Meeting. AEC Files, MRA-5.

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